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# Identifying Patient Attitudinal Clusters Associated with Asthma Control: The European REALISE Survey



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**What is already known about this topic?** Asthma management and treatment guidelines are driven predominantly by patient phenotype and clinical characteristics. However, psychological factors, such as patient attitudes and beliefs, are increasingly recognized as being additional determinants of clinical outcomes.

**What does this article add to our knowledge?** REcognise Asthma and Link to Symptoms and Experience (REALISE) survey respondents could be categorized into one of 5 attitudinal clusters reflecting common beliefs and attitudes toward asthma and its management. Clusters differed markedly in important clinical aspects including self-reported medication adherence and asthma control.

**How does this study impact current management guidelines?** Our findings build on existing guidelines by identifying specific patient attitudinal subgroups that may benefit from targeted interventions. Expert consensus is needed to establish how best to identify these subgroups and which interventions to use.

**BACKGROUND:** Asthma is a highly heterogeneous disease that can be classified into different clinical phenotypes, and treatment may be tailored accordingly. However, factors beyond purely clinical traits, such as patient attitudes and behaviors, can also have a marked impact on treatment outcomes.

**OBJECTIVE:** The objective of this study was to further analyze data from the REcognise Asthma and Link to Symptoms and Experience (REALISE) Europe survey, to identify distinct patient groups sharing common attitudes toward asthma and its management.

**METHODS:** Factor analysis of respondent data (N = 7,930) from the REALISE Europe survey consolidated the 34 attitudinal variables provided by the study population into a set of 8 summary factors. Cluster analyses were used to identify patient clusters that showed similar attitudes and behaviors toward each of the 8 summary factors.

**RESULTS:** Five distinct patient clusters were identified and named according to the key characteristics comprising that cluster: “Confident and self-managing,” “Confident and accepting of their asthma,” “Confident but dependent on

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*Abbreviations used*

*BIC*-Bayesian information criterion  
*GINA*-Global Initiative for Asthma  
*HCP*-Health care professional  
*LCA*-Latent class analysis  
*REALISE*-REcognise Asthma and Link to Symptoms and Experience

others,” “Concerned but confident in their health care professional (HCP),” and “Not confident in themselves or their HCP.” Clusters showed clear variability in attributes such as degree of confidence in managing their asthma, use of reliever and preventer medication, and level of asthma control.

**CONCLUSIONS:** The 5 patient clusters identified in this analysis displayed distinctly different personal attitudes that would require different approaches in the consultation room certainly for asthma but probably also for other chronic diseases. © 2018 The Authors. Published by Elsevier Inc. on behalf of the American Academy of Allergy, Asthma & Immunology. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>). (J Allergy Clin Immunol Pract 2018;6:962-71)

**Key words:** Asthma; Attitudes; Beliefs; Cluster; Control; Management; Patient

Asthma is a complex heterogeneous disease, encompassing multiple clinical phenotypes. A number of characteristics, including age at onset, triggering factors, presence of allergic features, and the nature of the underlying airway inflammation, have been used to distinguish between different asthma phenotypes.<sup>1</sup> This focus on “molecular” phenotypes has aimed at developing targeted asthma therapies.<sup>2</sup> However, identifying patients with different attitudinal or behavioral characteristics may also offer the potential for more personalized management. This is because patients’ attitudes, beliefs, and behaviors can all impact on their ability to manage and cope with their condition. New strategies to improve the management of chronic diseases should, therefore, take these aspects into consideration.<sup>3</sup>

In asthma, patient-reported outcomes, such as symptoms and quality of life, correlate strongly with psychosocial measures; furthermore, socioeconomic factors and psychological states, such as anxiety, are strongly related to asthma outcomes.<sup>4</sup> Indeed, patients’ attitudes to asthma and medications can influence treatment adherence, asthma control, and disease outcomes.<sup>5-10</sup> There is potential, therefore, for interventions addressing patients’ attitudes and beliefs to improve adherence and outcomes in asthma. Indeed, in adults with moderate-to-severe asthma, attitudes regarding treatments and relationships with medical professionals predicted future risk of uncontrolled asthma.<sup>11</sup> Identifying different attitudes and personality traits among patients with asthma thus has the potential to improve their management.

The REcognise Asthma and Link to Symptoms and Experience (REALISE) surveys, conducted in Europe and Asia, were large multicountry appraisals of patient attitudes and behaviors toward asthma and its management.<sup>12,13</sup> The REALISE Europe survey (N = 8,000) reported that more than 80% of patients with asthma did not consider themselves “sick,” and many ignored their asthma to “feel normal and fit in.”<sup>12</sup> The levels of

asthma control among respondents were low according to Global Initiative for Asthma (GINA) criteria,<sup>14</sup> with 45.1% having uncontrolled asthma, but more than 90% of patients considered their asthma to be controlled. The REALISE Asia survey, involving more than 2,400 patients with asthma from 8 countries, reported similar findings.<sup>13</sup> The levels of GINA-defined asthma control were low (49.7% uncontrolled), and patients’ perceptions of their level of asthma control were overestimated.

Here, we report findings from a multifactorial cluster analysis evaluating attitudinal data from the REALISE Europe survey to further explore patients’ attitudes toward managing their asthma and the impact of these attitudes toward asthma control.

## METHODS

### REALISE Europe survey

The REALISE Europe survey was a quantitative, questionnaire-based survey, conducted online in 11 countries (Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, and the United Kingdom) between July and October 2012. Full details of the survey design and methodology have been reported previously, so only a brief overview is provided here.<sup>12</sup>

Eligible respondents were aged 18 to 50 years, had a physician-confirmed asthma diagnosis and at least 2 asthma prescriptions in the previous 2 years, and used social media. The respondents who had participated in market research surveys within the previous 3 months were excluded.

The current analyses focus on REALISE survey questionnaire responses regarding patients’ attitudes toward asthma and its management. The respondents rated their level of agreement with 34 statements (referred to as attitudinal variables) on a 4-point scale (“strongly disagree,” “tend to disagree,” “tend to agree,” “strongly agree”). However, the frequency of using the extremes of the “agree-disagree” scales varied between countries, suggesting that cultural factors were biasing the patterns of responses. The response data were, therefore, dichotomized into simple “agree” or “disagree” categories to account for these differences. Asthma control was assessed using the 4 GINA 2011 criteria based on responses to questions from the Helping Asthma in Real-life Patients initiative (how many days in the previous 7 days respondents had day-time symptoms, had awoken at night or had their normal activities affected by asthma, and how many times they had used a reliever inhaler).

The survey was led by an independent Steering Committee, and all analyses were defined *a priori*. The survey was conducted by Incite Marketing Planning Limited (London, UK), in accordance with the Codes of Conduct of the Market Research Society, European Pharmaceutical Marketing Research Association, and Association of the British Pharmaceutical Industry, and guidelines from the British Healthcare Business Intelligence Association. Data were managed in accordance with the Data Protection Act (UK, 1998).

### Data analyses

**Factor analysis.** Factor analysis consolidated the 34 attitudinal variables provided by the study population into a set of 8 summary factors, containing related groups of attitudinal variables (Table I). It was performed using Statistica version 10 using the principal-components extraction method. All factors with eigenvalues greater than 1 were retained (Kaiser’s criteria), and Varimax rotation was used to aid interpretation.

**Cluster analyses.** Cluster analyses were used to divide respondents into groups of patients with similar attitudes and

**TABLE I.** Results of the factor analysis, showing the related groups of questionnaire statements (attitudinal variables) comprising the summary factors

Summary factors	Attitudinal statements
Impact on activities of daily living*	I have to take time off work because of my asthma
	My asthma affects my sex life
	My asthma affects my work
	My asthma makes me feel self-conscious when I want to be intimate with someone
	My asthma stops me living life to the full
Socially conscious about asthma*	I feel embarrassed using my asthma inhaler in front of others
	I feel embarrassed carrying my asthma inhaler around with me
	I ignore my asthma and its symptoms so I can feel normal and fit in with my friends/peers
	I find it a real nuisance having to use my inhaler
Stress in daily life*	I often have days where I feel stressed out
	If someone asked me, I would say I had a stressful life
	If I have a lot of things to do, I can get agitated and cross with people
	I often can't sleep at night, as I am worrying about what happened that day
	I wish I had more time to do the things I want to do
Anxious about asthma*	I worry about what my asthma will be like in 10 y
	I worry about the impact my asthma will have on my health in the future
	I am anxious about not knowing when my next asthma attack is coming
	I would like to have easier access to prescriptions for my asthma medication
	Having to take regular asthma medication worries me
Deprioritizing health*	I live for today, rather than worry about tomorrow
	I have no time to think about my health, as other things are more important
	When my asthma symptoms become worse, it is my own fault
Confidence in doctor†	My doctor (or nurse) doesn't understand my asthma
	I have discussed my asthma with my doctor, but it didn't answer all of the questions I had
	I know better than my doctor how to manage my asthma
	I find my inhaler difficult to use
	I ignore my doctor's instructions about when and how often to take my medication
Asthma dominates life†	I know how to manage my asthma without the help of my doctor
	I have control over my asthma
	My symptoms are not serious
Accepting the asthma label†	I see myself as healthy and fit
	Don't label me as a person who is sick
	I am not like other people with asthma
	I just get on with my life; I don't think about my asthma

\*Individuals who agreed with statements in the factor group received a higher factor score.

†Individuals who disagreed with statements in the factor group received a higher factor score.

behaviors regarding asthma, based on their ratings of each of the 8 summary factors, minimizing factor differences within a group and maximizing factor differences between groups. Cluster names were defined according to the predominant characteristics and behaviors of patients in each cluster. Potential cluster names were suggested initially by all 3 authors, who subsequently discussed and refined the proposed terminology to ensure that a consensus was reached. Of the 8,000 respondents who completed the survey, 7,930 were included in the cluster analysis. The other 70 respondents were excluded because they used the same response category across all the attitudinal items; thus their responses were not considered an accurate reflection of attitudes to asthma. Latent class analysis (LCA) was used for the cluster analysis because it employs statistical (rather than mathematical) methodology. An ordered categorical regression model was used to identify significant discriminators among the candidate explanatory variables. Segmentation models with different numbers of clusters were derived using the LCA, and each respondent was classified (probabilistically) into one a cluster. The Bayesian

information criterion (BIC) assessed which models showed the best fit to the survey response data.

GINA-defined control status was included as a covariate in the cluster analysis to improve the performance of the segmentation models. The LCA was performed using the Latent GOLD statistical package (Statistical Innovations, Belmont, Mass).

## RESULTS

### Survey respondents

The demographic and disease characteristics of the cluster analysis population (N = 7,930) are shown in Table II. More than 60% were female, and the mean age was 35 years. The majority of patients (70.7%) were diagnosed with asthma at least 11 years ago. Fewer than half (43.6%) used a preventer inhaler, and almost a quarter (23.6%) used a combination inhaler. Asthma was controlled, partially controlled, or uncontrolled in 20.2%, 35.0%, and 44.8% of patients, respectively.

**TABLE II.** Demographics and characteristics of the cluster analysis population

Demographic or characteristic	Respondents (N = 7,930)
Sex, n (%)	
Female	4,889 (61.7)
Male	3,041 (38.3)
Mean (±SD) age (y)	35 ± 9
Age range (y), n (%)	
18-25	1,524 (19.2)
26-35	2,662 (33.6)
36-40	1,362 (17.2)
41-50	2,382 (30.0)
Years since asthma diagnosis*, n (%)	
1 or less	230 (3.3)
2-5	771 (11.0)
6-10	1,059 (15.1)
11 or more	4,974 (70.7)
Current smokers†, n (%)	1,796 (22.6)
Comorbidities‡, n (%)	
Depression	1,781 (22.5)
High BP/hypertension	1,193 (15.0)
Diabetes	861 (10.9)
Rheumatoid arthritis	660 (8.3)
COPD	480 (6.1)
Heart disease	415 (5.2)
Cancer	216 (2.7)
Treatment type, n (%)	
Taking preventer inhaler	3,458 (43.6)
Taking reliever inhaler	6,111 (77.1)
Prescribed preventer inhaler	3,458 (43.6)
Prescribed combination inhaler	1,874 (23.6)
Prescribed oral pill	1,810 (22.8)
Other medications	821 (10.4)
No or unknown treatment	782 (9.9)
GINA-defined asthma control, n (%)	
Controlled	1,599 (20.2)
Partially controlled	2,778 (35.0)
Uncontrolled	3,553 (44.8)

BP, Blood pressure; COPD, chronic obstructive pulmonary disease; GINA, Global Initiative for Asthma; SD, standard deviation.

\*n = 7034.

†Combines answers for respondents who described themselves as “still smoking,” as opposed to “never smoked tobacco,” “have tried tobacco in the past, but don’t currently smoke,” and “used to smoke tobacco, but don’t now.”

‡Self-reported by respondents as having been diagnosed by a doctor, in response to the question: “Do you currently suffer from any of the following illnesses, which have been diagnosed by a doctor?”

## Cluster analysis

The analysis of BIC values showed that model performance improved as the number of clusters increased from 1 to 5, with a minimal change with more than 6 clusters. With larger numbers of clusters, some groups had too few respondents to profile accurately. As such, 2 segmentation models that divided the patients into 5 and 6 clusters, respectively, were considered for further analysis.

Summary factor scores for the 5-cluster analysis are shown in Figure 1, showing 5 distinct patient clusters that differ in their attitudes to the summary factors. By contrast, summary factor scores for the 6-cluster analysis showed that 2 groups of

respondents (clusters 4 and 5) were similar except for 1 factor. Moreover, any improvement in the BIC value was minimal compared with the 5-cluster analysis. The 5-cluster analysis was, therefore, selected as the best model for the data.

The 5 patient clusters were named according to the attitudes of patients to the summary factors: “Confident and self-managing” (cluster 1), “Confident and accepting of their asthma” (cluster 2), “Confident but dependent on others” (cluster 3), “Concerned but confident in their health care professional (HCP)” (cluster 4), and “Not confident in themselves or their HCP” (cluster 5).

Cluster 2 contained the largest number of patients, comprising 35% of the overall population (Figure 2). Clusters 1 (26%) and 4 (28%) were similar in size, whereas clusters 3 and 5 were the smallest (each approximately 5%). The distribution of patients between groups varied across the 11 countries (Figure 2).

## Key patient characteristics for each cluster

Patient demographics and characteristics for each cluster are shown in Table III. Apart from the “Not confident in themselves or their HCP” cluster, there were slightly more female than male patients in each cluster, and patients were distributed fairly evenly between the age categories.

**“Confident and self-managing” (cluster 1).** Patients in this cluster had the following characteristics: their daily lives were the least affected by asthma compared with other clusters, and they were much less anxious or socially conscious about their condition than the average for the population (Figure 1). They had high confidence in doctors and were the most independent when it came to asthma management but were less accepting of the asthma label.

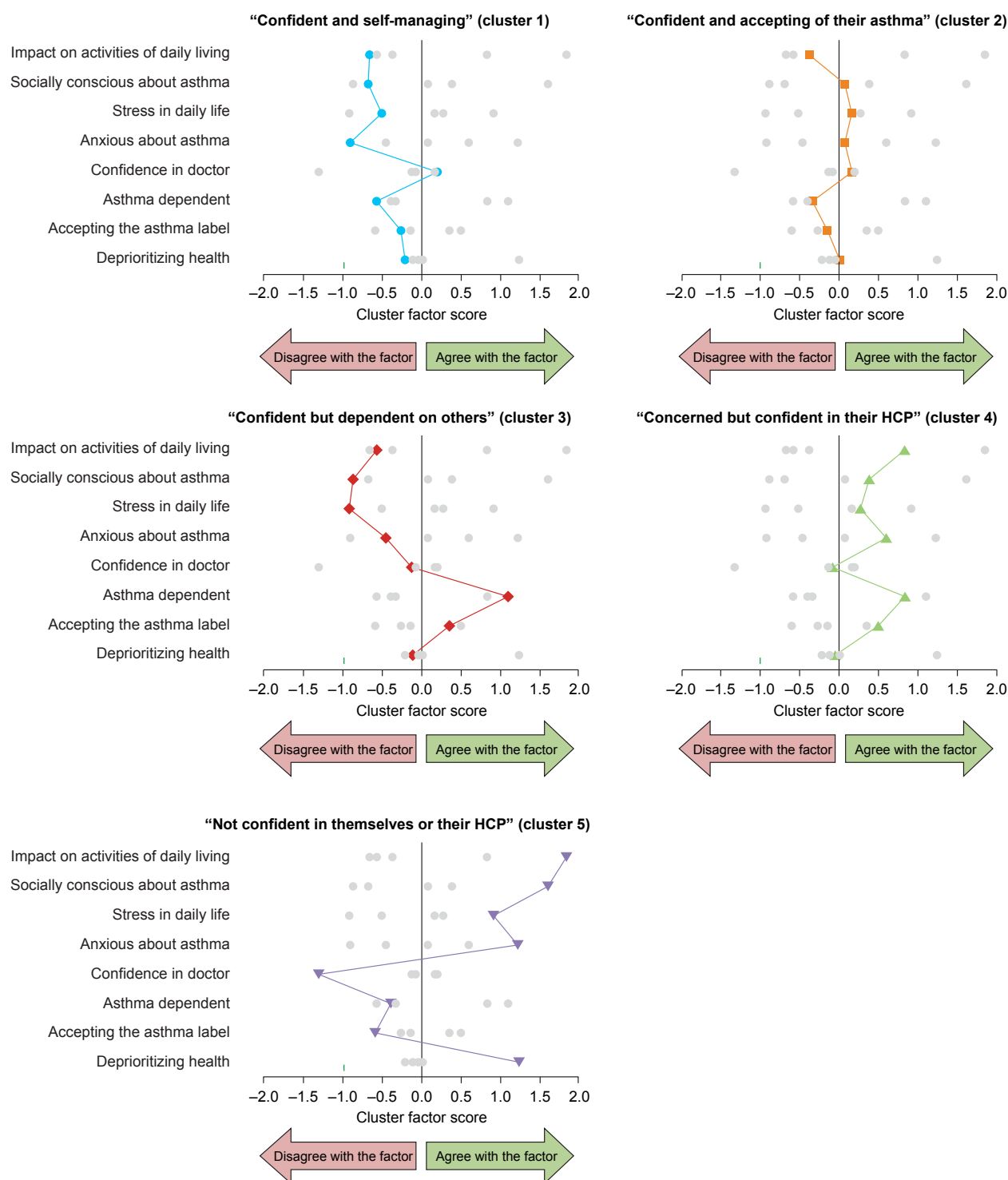
Cluster 1 patients had the highest confidence in managing their asthma (98.2% “fairly/very confident”), were the least worried about when the next asthma attack was coming, and had the lowest level of asthma information seeking (Table IV). They also had the lowest rate of reliever use (50.6% reported no use in the past 7 days) and a high rate of preventer inhaler use (44.9%; Table IV). Asthma control was highest in this cluster, with 89.6% of patients either controlled or partially controlled.

**“Confident and accepting of their asthma” (cluster 2).** This cluster comprised patients whose daily lives were less affected by asthma than the population average and who were only slightly more anxious or socially conscious about asthma than the average (Figure 1). They had higher levels of confidence in doctors than all other clusters, except cluster 1.

Most considered their asthma to be “not serious” (92.3%) and had a high level of confidence in managing their asthma (94.4% “fairly/very confident”; Table IV). Their asthma concerns were low, as was the frequency of information seeking about asthma. Patients in this cluster showed a moderate degree of asthma control, with 69.5% either controlled or partially controlled (Table III). Approximately half reported nighttime symptoms or awakenings as a result of asthma (47.4%) and that asthma interfered with their daily activities (51.3%; Table IV).

**“Confident but dependent on others” (cluster 3).** This cluster comprised patients whose daily lives were less affected by asthma and who were less concerned about asthma and its treatment than the population average (Figure 1). They were the least socially conscious about asthma and using inhalers,





**FIGURE 1.** Summary factors scores for the individual patient clusters in REALISE Europe based on a 5-cluster analysis. Colored symbols indicate the scores for each respective cluster; gray symbols indicate the equivalent scores in the other clusters. *HCP*, Health care professional.

and were least stressed in daily life, but were the most dependent on others regarding asthma management.

Cluster 3 patients had the lowest levels of preventer inhaler use (35.7%) but moderate levels of information seeking about

asthma (Table IV). Asthma concern levels were low, and confidence in managing asthma was high. However, these patients showed only a moderate degree of asthma control, with 52.5% either controlled or partially controlled.

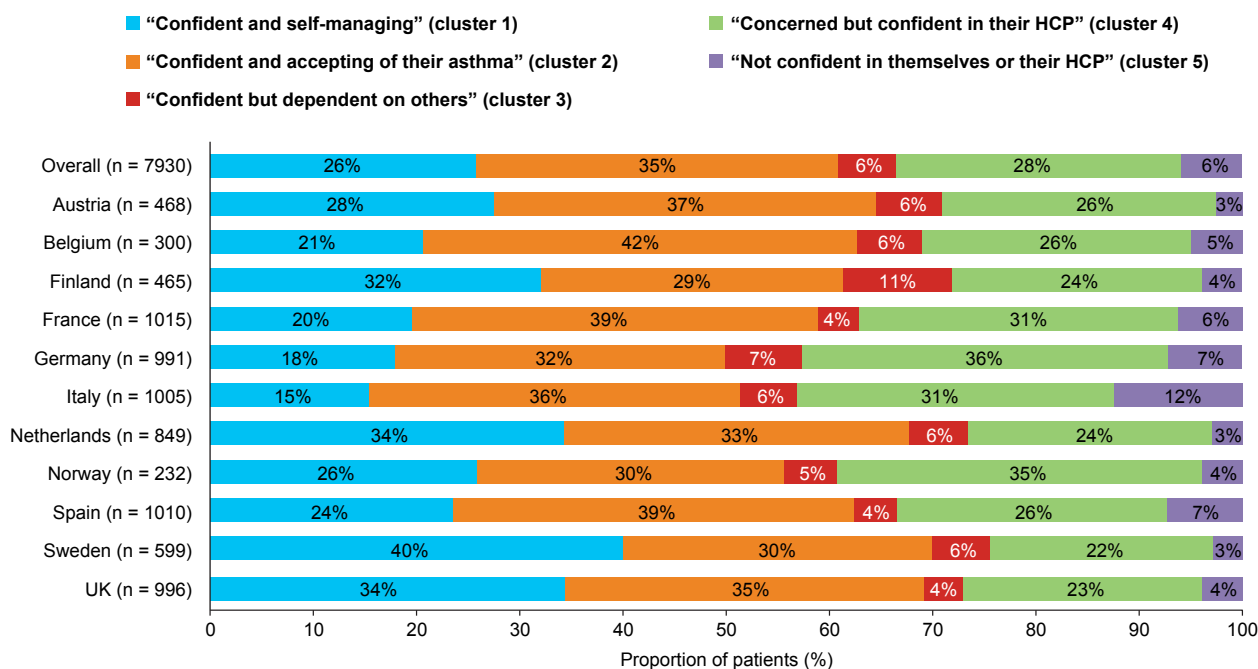


FIGURE 2. Distribution of patients among the 5 clusters, overall and by country. *HCP*, Health care professional.

TABLE III. Demographic characteristics and GINA-defined asthma control for patients in each of the 5 clusters

	Cluster 1 "Confident and self-managing"	Cluster 2 "Confident and accepting of their asthma"	Cluster 3 "Confident but dependent on others"	Cluster 4 "Concerned but confident in their HCP"	Cluster 5 "Not confident in themselves or their HCP"
Demographic or characteristic	N = 2044	N = 2782	N = 442	N = 2194	N = 468
Sex, n (%)					
Male	689 (33.7)	922 (33.1)	192 (43.4)	986 (44.9)	252 (53.8)
Female	1,355 (66.3)	1,860 (66.9)	250 (56.6)	1,208 (55.1)	216 (46.2)
Age range (y), n (%)					
18-25	383 (18.7)	549 (19.7)	100 (22.6)	419 (19.1)	73 (15.6)
26-35	670 (32.8)	912 (32.8)	135 (30.5)	729 (33.2)	216 (46.2)
36-40	347 (17.0)	481 (17.3)	65 (14.7)	388 (17.7)	81 (17.3)
41-50	644 (31.5)	840 (30.2)	142 (32.1)	658 (30.0)	98 (20.9)
GINA-defined asthma control, n (%)					
Controlled	975 (47.7)	542 (19.5)	52 (11.8)	20 (0.9)	10 (2.1)
Partially controlled	856 (41.9)	1,392 (50.0)	180 (40.7)	283 (12.9)	67 (14.3)
Uncontrolled	213 (10.4)	848 (30.5)	210 (47.5)	1,891 (86.2)	391 (83.5)

GINA, Global Initiative for Asthma; *HCP*, health care professional.

Furthermore, more than 60% of patients experienced nighttime awakenings and reported normal activities being affected by asthma (Table IV), yet only 7% agreed that asthma stopped them from living life to the full.

**"Concerned but confident in their HCP" (cluster 4).** These patients were concerned about their asthma but confident in their HCP; asthma had a greater impact on them relative to the overall population, in terms of daily activities and being anxious and socially conscious about asthma (Figure 1). These patients were more dependent on others than average in

terms of asthma management and were the most receptive to the asthma label.

More than one-third (37.1%) of patients considered their asthma to be serious, and 51.6% were concerned about their asthma, both of which were greater than for the other clusters (Table IV). The frequency of information seeking was high, with 30.5% of patients looking for information about asthma at least weekly. Confidence in managing asthma was the lowest in this cluster, with 16.5% not confident in managing their asthma. These patients had the lowest level of asthma control, with only 13.8% having controlled or partially controlled asthma.

**TABLE IV.** Patient perceptions about asthma and indicators of asthma symptoms in each of the 5 clusters

	Cluster 1 "Confident and self-managing" N = 2,044	Cluster 2 "Confident and accepting of their asthma" N = 2,782	Cluster 3 "Confident but dependent on others" N = 442	Cluster 4 "Concerned but confident in their HCP" N = 2,194	Cluster 5 "Not confident in themselves or their HCP" N = 468
Patient perceptions of and information seeking about asthma					
Confident in managing asthma					
Very/fairly	2,007 (98.2)	2,627 (94.4)	407 (92.1)	1,831 (83.5)	399 (85.2)
Not very/not at all	37 (1.8)	155 (5.6)	35 (7.9)	363 (16.5)	69 (14.8)
Perceived seriousness of asthma					
Not very/not at all	1,979 (96.8)	2,568 (92.3)	365 (82.6)	1,380 (62.9)	332 (70.9)
Very/fairly	65 (3.2)	214 (7.7)	77 (17.4)	814 (37.1)	136 (29.1)
Concerned about asthma					
Not very/not at all	1,985 (97.1)	2,271 (81.6)	357 (80.8)	1,061 (48.4)	267 (57.1)
Very/fairly	59 (2.9)	511 (18.4)	85 (19.2)	1,133 (51.6)	201 (42.9)
Socially conscious about asthma					
I ignore my asthma and its symptoms					
Disagree*	1,422 (69.6)	1,356 (48.7)	410 (92.8)	1,316 (60.0)	66 (14.1)
Agree†	622 (30.4)	1,426 (51.3)	32 (7.2)	878 (40.0)	402 (85.9)
I feel embarrassed carrying my inhaler around with me					
Disagree*	2,003 (98.0)	2,129 (76.5)	436 (98.6)	1,297 (59.1)	50 (10.7)
Agree†	41 (2.0)	653 (23.5)	6 (1.4)	897 (40.9)	418 (89.3)
I feel embarrassed using my inhaler in front of others					
Disagree*	2,003 (98.0)	2,129 (76.5)	436 (98.6)	1,297 (59.1)	50 (10.7)
Agree†	41 (2.0)	653 (23.5)	6 (1.4)	897 (40.9)	418 (89.3)
Worried about not knowing when next asthma attack is coming					
Disagree*	1,857 (90.9)	1,710 (61.5)	321 (72.6)	865 (39.4)	72 (15.4)
Agree†	187 (9.1)	1,072 (38.5)	121 (27.4)	1,329 (60.6)	396 (84.6)
Information seeking about asthma					
At least once a week‡	32 (1.6)	153 (5.5)	63 (14.3)	669 (30.5)	240 (51.3)
Monthly to yearly§	483 (23.6)	1,080 (38.8)	169 (38.2)	926 (42.2)	162 (34.6)
Less than once a year	520 (25.4)	609 (21.9)	65 (14.7)	226 (10.3)	29 (6.2)
None ("I don't look for information")	1,009 (49.4)	940 (33.8)	145 (32.8)	373 (17.0)	37 (7.9)
Indicators of asthma symptoms and preventer inhaler use					
Nighttime symptoms/awakenings*					
None	1,576 (77.1)	1,462 (52.6)	167 (37.8)	371 (16.9)	53 (11.3)
≥1 d	468 (22.9)	1,320 (47.4)	275 (62.2)	1,823 (83.1)	415 (88.7)
Days with symptoms					
None	862 (42.2)	548 (19.7)	90 (20.4)	85 (3.9)	29 (6.2)
≥1 d	1,182 (57.8)	2,234 (80.3)	352 (79.6)	2,109 (96.1)	439 (93.8)
≥3 d	286 (14.0)	883 (31.7)	189 (42.8)	1,616 (73.7)	321 (68.6)
Normal activities affected by symptoms*					
None	1,570 (76.8)	1,354 (48.7)	173 (39.1)	210 (9.6)	44 (9.4)
≥1 d	474 (23.2)	1,428 (51.3)	269 (60.9)	1,984 (90.4)	424 (90.6)
Preventer inhaler use					
Yes	917 (44.9)	1,180 (42.4)	158 (35.7)	1,015 (46.3)	188 (40.2)

(continued)

**"Not confident in themselves or their HCP" (cluster 5).** This category comprised patients who were the most affected by asthma in their daily activities, who experienced the

greatest psychological burden, who were the most anxious about their asthma, and who were the most socially conscious about asthma and using inhalers (Figure 1). Despite this, patients were



TABLE IV. (Continued)

	Cluster 1 "Confident and self-managing"	Cluster 2 "Confident and accepting of their asthma"	Cluster 3 "Confident but dependent on others"	Cluster 4 "Concerned but confident in their HCP"	Cluster 5 "Not confident in themselves or their HCP"
	N = 2,044	N = 2,782	N = 442	N = 2,194	N = 468
No	1,057 (51.7)	1,402 (50.4)	226 (51.1)	956 (43.6)	211 (45.1)
Don't know	70 (3.4)	200 (7.2)	58 (13.1)	223 (10.2)	69 (14.7)
Reliever inhaler use					
None	981 (50.6)	860 (32.6)	95 (22.9)	175 (8.2)	2,137 (28.2)
≥1 time	959 (49.4)	1,780 (67.4)	319 (77.1)	1,957 (91.8)	431 (94.3)
≥3 times	420 (21.6)	881 (33.4)	202 (48.8)	1,536 (72.0)	3,378 (44.5)
≥10 times	69 (3.6)	129 (4.9)	35 (8.5)	263 (12.3)	511 (6.7)

Data are shown as the number of patients (%).

HCP, Health care professional.

\*Strongly disagree or tend to disagree.

†Strongly agree or tend to agree.

‡Includes the categories "several times a day," "every day," "2 to 5 times a week," and "every week."

§Includes the categories "1 or 2 times a month," "every 3 mo," "every 6 mo," and "every year."

||In the previous 7 d.

the least accepting of the asthma label. Furthermore, patients deprioritized their health to a much greater extent than the overall population and were more independent than average when it came to asthma management. They had the least confidence in doctors of all the clusters.

Cluster 5 patients perceived their asthma to be serious, and confidence in managing their disease was low (Table IV). Preventer inhaler use was the second lowest among the clusters (40.2%), and most patients (84.6%) were worried about when the next asthma attack was coming. Information seeking was high, with 51.3% searching for asthma information at least weekly. Asthma control was low, with only 16.4% either controlled or partially controlled.

## DISCUSSION

This analysis of the REALISE Europe survey results showed that patients with asthma can be divided into 5 distinct clusters based on their attitudes toward 8 aspects of asthma and its management. Because the survey was administered online, and all respondents were active on "social media," the data reflect the attitudes of a "new era" of patients with asthma likely to be receptive to multiple sources of information about their condition.

A similar analysis of the attitudes of adult Asian patients with asthma was performed using data from the REALISE Asia survey (8 countries, N = 2,467).<sup>15</sup> Information was collected using an online questionnaire and analyzed using the same 2-stage methodology as the European data. Factor analysis reduced the 27 Asian attitudinal variables to 9 summary factors, and cluster analysis identified 5 distinct groups that had clear similarities to the European clusters, although some differences were apparent.<sup>15</sup> Both analyses identified a cluster whose patients had high levels of asthma control; high levels of confidence in managing asthma; low perceptions about asthma severity, concern, and social consciousness; and low information-seeking behavior (cluster 1). Likewise, the "Worried with multiple symptoms" cluster from the Asian analysis was similar to the European "Concerned but confident in their HCP" cluster, and

there were strong similarities between the "Adrift and poorly controlled" (Asia) and "Not confident in themselves or their HCP" (Europe) clusters. Similarities were also observed between the Asian "In denial about symptoms" and European "Confident and accepting of their asthma" clusters.<sup>15</sup> Together, these findings provide clear evidence that opportunities exist for management approaches to be tailored according to the beliefs and behaviors of each cluster, to help improve disease awareness, management, and control.

Another cluster analysis of adults with asthma taking maintenance medications conducted in the United States identified 5 distinct groups of patients based on their illness perception and medication beliefs.<sup>16</sup> Individuals in 2 of these clusters were adherent, whereas those in the other 3 clusters were non-adherent. Adherent clusters were accepting of their illness and had strong beliefs in the necessity of medication, and concerns about its use were low. The nonadherent clusters were categorized as "indifferent," "ambivalent," and "skeptical," based on attitudes toward the need for medication, concerns about its use, and perceptions about their illness. As with adherent patients, nonadherent patients with few concerns had well-controlled asthma, whereas those with strong concerns had uncontrolled asthma. This association between negative patient attitudes and poor outcomes strongly suggests that targeted interventions need to consider more than just the clinical characteristics of a patient.<sup>16</sup>

Our analysis of the REALISE Europe data shows how this "new era" of patients who are active on social media also tend to exhibit distinct behavioral types. Patients in different clusters may require different approaches and have different needs; hence HCPs will need to communicate and engage effectively with each type to better manage their asthma. The clusters with the lowest GINA-defined asthma control, "Concerned but confident in their HCP" and "Not confident in themselves or their HCP," may be key groups for HCP intervention. For example, patients in the "Concerned but confident in their HCP" cluster had high levels of information-seeking behavior and confidence in their HCP. Thus, there is an opportunity to help these patients gain better asthma control and relieve their concerns by providing

clear and reliable information, checking the inhaler technique, and reviewing their medication. In the “Not confident in themselves or their HCP” cluster, patients were anxious and worried about when they might have an asthma attack, suggesting a need to build confidence in managing their asthma by providing trustful and frequent support. More than half of patients in this cluster searched for asthma information at least weekly, meaning more could be done to build trust in their HCP and to help them accept that they have asthma while reducing their concerns about social stigma and overall anxiety. In the “Confident but dependent on others” cluster, patients were not anxious or information-seeking, yet despite having confidence in managing their disease, they were dependent on their doctor. Nearly half of patients in this cluster had uncontrolled asthma, suggesting that more HCP-guided education and empowerment may improve self-management and asthma control while reducing reliance on their doctor.

Several studies have shown how personality traits and medication beliefs can affect treatment adherence, outcomes, and quality of life in patients with asthma.<sup>5-10</sup> Patients' beliefs in their own ability and the ability of treatments to control asthma symptoms, and viewing asthma as a chronic illness that requires maintenance medication, have been associated with good outcomes and quality of life.<sup>6</sup> By contrast, negative beliefs about the potential for asthma control and the perception that asthma is an episodic disease with few adverse consequences have all been associated with reduced treatment adherence.<sup>5</sup> Patients' beliefs about asthma medication also affect treatment adherence, with positive beliefs associated with improved adherence, and negative concerns linked with reduced adherence.<sup>7-9</sup> In one study in adults with asthma, 3 particular personality traits were more likely to be associated with poor adherence than other traits, and individuals with these traits also showed increased concerns about asthma medication.<sup>17</sup> Interventions specifically aimed at addressing medication concerns in these patients, such as shared decision making, individualizing treatment choice, and tailoring education, could therefore have a beneficial effect on adherence.<sup>18-20</sup>

However, the challenge remains regarding how to identify which attitudinal cluster a patient belongs to. One possibility is for HCPs to explore patient attitudes and beliefs during consultations and use these responses to judge which cluster a patient corresponds to. Patient-centered techniques, such as those drawing on motivational interviewing principles developed for adherence counseling, can help HCPs to ascertain the views, beliefs, and concerns a patient may have about asthma and its medication.<sup>21</sup> A short validated questionnaire or online profiling tool that patients complete in advance of a consultation could also be developed, which automatically calculates which cluster a patient belongs to.

One such tool was developed recently by an international expert panel during a 3-round Delphi consensus study exploring the REALISE Asia survey results.<sup>22</sup> They created an Asthma Patient Profiling Tool, comprising 10 short questions to which the patient responds “Agree/Disagree.” The HCP also indicates whether the patient has controlled, partly controlled, or uncontrolled asthma, and an attitudinal classification is generated automatically. The expert panel also proposed pharmacological and nonpharmacological recommendations tailored to each

cluster, and a Management Pathway Algorithm illustrating how to best implement each recommendation.<sup>22</sup> However, the tool was only developed very recently and as such is yet to be validated; also, patients were not involved during its design.<sup>22</sup> Thus, it currently remains unknown to what extent the tool may improve the management of patients in real-world settings. Likewise, the authors of the US cluster analysis took into consideration the different beliefs and perceptions of patients in each cluster before proposing different potential intervention strategies to improve adherence in the nonadherent groups.<sup>16</sup> A similar approach could be applied to the current cluster analysis from the REALISE Europe survey to develop tailored strategies for European patients, although any such instruments would take time to develop, test, and validate before being implemented. There may be practical challenges associated with implementing these interventions into daily clinical practice, given the increasing time and resource pressures facing HCPs. It is important that any tools developed to assist with implementation are readily accessible and easy to use.

A limitation of this study arises from its online survey-based design. Any analysis based on survey and online responses carries a potential inherent bias, in that the sample population comprises only those individuals able and willing to respond. Therefore, the phenotypes identified in the analysis and the relative numbers of individuals classified into these phenotypes may not be representative of the full asthma population and generalizable to all patients. Also, the analyses are correlative and so do not prove a causal link between the clusters and asthma control. Finally, naming of the clusters was defined according to the predominant characteristics and behaviors of patients in each cluster, but was done subjectively by the authors. The names were discussed and refined by all 3 authors to ensure that a consensus was reached.

In conclusion, analyses of data from the REALISE Europe survey have identified 5 distinct attitudinal clusters of patients who may have different clinical needs, and require different approaches to optimize their asthma management. Future research should focus on examining how these findings can be applied to clinical practice, in terms of how to determine quickly and accurately which cluster a patient belongs to and how interventions can be tailored accordingly.

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